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THE GILMORE STREET BRIDGE — JACKSONVILLE, FLORIDA

by Paul M. Huddleston

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THE GILMORE STREET BRIDGE

Jacksonville, Florida

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The Jacksonville Expressway, which was conceived after World War II and is now under construction, includes a primary north-south limited access route through the City of Jacksonville. This route, which is a link in the Interstate System, connects U. S. Highway No. 1 north of the city limits of Jacksonville, and U. S. Highway No. 17 south of the city limits of Jacksonville.

This connection between the two major highways dictated a crossing of the St. Johns River. Surveys and studies indicated that this river crossing should be made between the Riverside area of Jacksonville, and the section known as the Southside. The alignment was established between Gilmore Street, in Riverside, and Gary Street, on the Southside. The proposed bridge then became known as the Gilmore Street Bridge.

Studies of river ship and boat traffic indicated that a medium level bridge with a movable span would meet all vehicular traffic requirements. Also, the physical condition of the terrain on either side of the river indicated that this type of structure was highly desirable from an economic standpoint. The traffic studies dictated a four-lane structure having two lanes for northbound traffic and two lanes for southbound traffic. The State Road Department of Florida, in conjunction with the Bureau of Public Roads, established the design vehicular speed at 60 miles per hour which dictated the general geometry of the structure. As this bridge was to become an integral part of the Interstate System, the required design loading was H 20 S 16 in accordance with A.A.S.H.O. Specifications. The Corps of Engineers of the Department of the Army established that river navigation required a movable span providing 174 feet clear horizontal opening and a minimum vertical clearance of 37 feet above mean sea level when the movable span was in the closed position.

Figure 1 is a delineation of the bridge looking northeast, with the downtown section of the City of Jacksonville in the background.

This bridge is, at this writing, under construction. The substructure has been completed, and the superstructure is approximately one-fourth erected.

The bridge, which was finally developed after due consideration of all the design criteria and the economic aspects, is briefly described as follows:

It is a four-lane deck type steel highway bridge over the St. Johns River in Jacksonville, extending from Gilmore Street on the west bank to Gary Street on the east bank, a distance of approximately 3,667 feet between centers of abutment bearings. Reading from east to west, the bridge consists of five - three-span continuous rolled beam sections founded on the east abutment (pile bent No. 1), bents Nos. 2 through 15 and pier No. 16; one three-span continuous plate girder bridge section founded on piers Nos. 16 through 19; one three-span continuous truss section founded on piers

Nos. 19 through 22; a truss type double leaf bascule movable span, 207'-6" between centers of trunnions, founded on piers Nos. 22 and 23; one three-span continuous truss section founded on piers Nos. 23 through 26; and four three-span continuous rolled beam sections founded on piers Nos. 26 through 37 and the west abutment (pile bent No. 38).

With the exception of steel grating on the movable span, the bridge has a concrete deck with concrete safety curb and center mall throughout its length. The bridge has concrete handrailing throughout with the exception of the movable span which has structural steel railing.

Figure 2, a line elevation of the structure, shows the general aspects of the bridge.

The substructure of the project may be described as follows:

The two abutments of the structure are of the spill-through type with sufficient wing walls to protect the end bearings from the earth fill. Each of the abutments is founded on nine 73-pound steel bearing piles. Alternate interior and the end piles of the bent are battered to effectively resist lateral loads. All of the piles are encased with concrete from the cap to a point below ground water so as to protect the piles from corrosion. The piles were driven to a bearing of more than 60 tons. The tips of the piles developed bearing after penetrating approximately 15 feet in the subsurface strata of fossiliferous limerock and marl.

There are fourteen pile bents near the easterly end of the structure. These bents are composed of a reinforced concrete cap and encased 73-pound steel bearing piles. Of these fourteen bents there are five anchor bents with fourteen piles, all battered to resist longitudinal bridge loads, and nine bents with eleven piles. For transverse stability, the end piles of all bents are battered. The piles were driven as described above.

With the exception of the piers supporting the bascule leaves, there are eleven river piers. These piers consist of reinforced concrete shafts founded on a pile cap, seal and 73-pound steel bearing piles, driven as described above.

All piers were constructed from an open cofferdam. The concrete seals vary in thickness from 6 to 18 feet, depending on the depth of the river at the pier location. In all cases the seal extends below the normal river bottom so as to insure against pile corrosion.

There are nine piers on land near the west end of the structure. The construction of these piers is similar to the river piers, except, of course, the seal is not necessary. The piles were driven to bearing and the caps poured, using open excavations. The ground water was controlled using surface pumps.

The movable span is founded on piers Nos. 22 and 23. Pier No. 22, which is the easterly of the two bascule piers, is founded on 180 - 73-pound steel bearing piles. The other bascule pier, No. 23, is founded on 192 steel bearing piles. All bearing piles were driven to a bearing value of more than 60 tons. The piles were, in all cases, driven through the strata of limerock and bearing obtained in the underlying strata of marl. Pier No. 22 has a seal 12 feet thick and pier No. 23 has a seal 15 feet thick.

Each of the piers has two pile caps, one on either side of the roadway. From each of these pile caps two concrete shafts rise to elevation -1. At that elevation, the two shafts on each pile cap are connected with a longitudinal concrete beam 12 feet wide and 6 feet deep. From the top of these beams, the piers are of hollow construction with sufficient solid portions to carry the roadway loads. The space thus provided in the hollow portion

of the piers is utilized for transformers, switchgear and other necessary electrical and mechanical items. Adjacent and parallel to the river channel, the two portions of each pier are connected at elevation 30 by a transverse concrete beam 10 feet 6 inches wide and 13 feet deep, which serves as a tie between the two halves of each pier and a platform for the lifting machinery. The piers extend upward to the elevation of the roadway, and on the south side of pier No. 23, the bridge operator's control house is located.

To complete the substructure, a fender system between the two bascule piers has been constructed. The fender system is so designed to give adequate protection to the piers from passing river traffic and to provide the required 174 feet clear channel width. The fender system was constructed of treated wood piling and treated fender timbers.

The design and construction of the substructure set no records. However, the construction of pier No. 25 presented an interesting and somewhat unusual problem. This pier was located in the river where the water was approximately 46 feet deep. Below the bottom of the river was about 15 feet of river silt, over 4 feet of fine sand which in turn was located on top of a firm sedimentary sandy marl.

The pier was designed as a 3-shaft rigid frame founded on steel bearing piles, which required three separate cofferdams and seals. The 18-foot thick seals were placed between elevation -63 and -45.

Three cofferdam frames, minus any bracing but with vertical posts at all corners, were constructed on shore, in the exact position in relation to each other as they were to occupy inside the cofferdams. The three frames were tied together by welding steel beams across the top wales. These beams served as spacers and provided points for lifting the entire assembly. The three frames, in one assembly, were then picked up by two cranes and loaded on two barges. The barges were towed into the river, to the approximate location of Pier No. 25, and tied to the anchored crane barges.

The barges containing the cofferdam frames were then moved to the exact position of pier No. 25. This was done by instrumentmen on triangulation stations with radio communication. When the frames were in the exact position, 80-foot steel spuds were driven at the four outside corners of the frame assembly.

The frames were then lifted, the barges pulled out, and the frames lowered along the spuds. Once the frames were in place, 70-foot and 80-foot sections of steel sheet piling were driven around them, without incident.

Excavation of the river silt and sand inside the cofferdams was found to be impracticable by using an ordinary bucket. This was due to the relatively small cofferdam and the proportionately deep hole. The contractor tried an airlift, consisting of a 10-inch pipe and a large Diesel-driven compressor, and found that the material could be excavated with little effort. The airlift excavated at an average of 10 cubic yards of material per hour, and eliminated the danger of damage to the cofferdam frames which is ever present with bucket excavation. The piles were driven and the seals poured without incident.

Up to this point there had been no internal bracing of any type installed between the members of the cofferdam frames which served as wales.

After the concrete in the seals had aged sufficiently, the pumping operations were started on each of the cofferdams. As the water was pumped out and each ring of wales exposed, the pumps were adjusted so that the water was held at a point slightly below the ring until internal bracing could be

welded between the wales. This procedure was followed throughout the depth of the cofferdam, which included a total of 7 rings of wales. When the cofferdams were completely dewatered, the pier shafts were constructed in the normal manner.

During the construction of pier No. 25 and, for that matter, all of the other piers and bents in the river, 2-way radio communication was utilized to the greatest extent possible. "Walkie-talkie" radio equipment permitted many jobs to be performed in a fraction of the normal time. This was particularly true between instrumentmen on triangulation stations and rodmen on barges or on cofferdams in the river. The radio network used consisted of several "walkie-talkie" transmitters and receivers, and larger transmitters and receivers on all floating cranes, work boats and tugs, all of which were on the same wave length. This communication system afforded instant communication between members of the contractor's forces and the engineering forces.

The superstructure may be described as follows:

On either end of the bridge there are bridge sections composed of three-span continuous rolled beams. These bridge sections consist, in general, of end spans 61' long and a center span of 87'. The beams are spaced across the roadway at 6'-8" centers with diaphragms approximately 22' apart. The beams are 36" - 194-pound carbon steel wide flange sections. In the areas of maximum positive moment, composite sections are utilized using Alpha spirals as shear developers. This composite construction is desirable in order to reduce the live load deflection in the center span. The deflection thus obtained is well within the limits specified by A.A.S.H.O. These bridge sections all have a deck of concrete 7" thick.

West of the beam bridge sections on the east side of the river channel there is a three-span continuous plate girder bridge section. This section of the bridge has flanking spans of 130' and a center span of 154'. It is composed of four plate girders, two to each roadway. The girders are 8'-0-1/2" back to back to flange angles. They have 9/16" web and 8 x 8 x 3/4" flange angles. In the area of the interior supports, the girders have two 18" x 3/4" cover plates top and bottom. At points of maximum positive moment the girders have one 3/8" x 18" cover plate top and bottom. The roadway is supported on a floor system consisting of floor beams which are 24" - 84-pound wide flange sections spaced 22' on centers and stringers which are 21" - 62-pound wide flange sections spaced 6'-4" on centers. The deck is a 7" concrete slab.

On each side of the movable span there is a bridge section consisting of three-span continuous trusses. These trusses have 168' flanking spans and a 224' center span. Each section consists of three trusses, one located under each safety curb and one under the center mall. Chords and webs of the trusses are 14" wide flange sections connected with gussets on each flange. The trusses support a floor system consisting of floor beams of 30" - 103-pound beams and 16" - 36-pound stringers. The floor beams are spaced at each panel point 14'-0" on centers. The stringers are spaced at 6'-6" on centers. The deck is a concrete slab 7" thick.

The movable span consists of a double leaf bascule span that is generally classified as the "Chicago" type. Each leaf consists of two trusses fabricated from 14" wide flange sections. The web members of the trusses, as indicated in Figure 3, are arranged so that the trunnion is mounted between web members, on a line between the center of gravity of the river arm and that of the counterweight arm. The trusses are spaced 58'-6-3/4" apart or

approximately under each safety curb. The deck, which consists of 5" steel grating for the roadways and checker plate for the curbs and mall, is supported by transverse trussed floor beams at each panel point. The panel points are 15'-6" on centers. Between the transverse trussed beams are stringers of 16" - 36-pound wide flange sections spaced 5' on centers. The floor grating is welded directly to the stringers. The trunnion consists of two steel castings mounted on either side of each truss, through which passes the trunnion shaft which is 18" in diameter and of Class A forged alloy steel. The two ends of the trunnion shaft are supported by cast steel bearings with phospher bronze bushings. These bearings, four for each leaf, are supported on the trunnion girder which passes through the trusses and spans between pier shafts on either side of the bridge. The trunnion girder is a box section 66'-6-1/4" long, which is composed of two 7/8" web plates, 4 - 8 x 8 x 1-1/8" angles and three cover plates 32" x 1" top and bottom. Each trunnion girder weighs approximately 59 tons. The girder not only supports the entire dead weight of the bascule leaf, but also that portion of roadway between the end bearings of the approach trusses and the floor break. The trunnion girder, the trunnions and the lifting machinery are shown in elevation by Figure 4.

Each bascule leaf is moved by a power train running from two 50 H.P. electric motors through a 55 to 1 ratio differential gear reducer to a pinion and gear and hence to the main pinion which drives an outside rack through an angle of 83°. There is a main pinion and a rack for each truss, the rack being mounted below the bottom chord. When in the closed position, the two leaves are locked together by two toggle type center locks and one bar type center lock. Two electric motors are mounted near the end of the west bascule leaf for the operation of the center locks. The leaves are geared and powered to move from the fully closed to the fully opened position in 90 seconds. The movable leaves are operated from a control desk in the control house. All items of the movable span are electrically interlocked so that the movable span can only be operated in the following sequence:

The operator must first operate the warning bells and lights, then the safety gates may be lowered. After the gates are completely lowered, the circuits to the center locks are automatically energized so that the locks may be released. When the locks are completely pulled, the main span motors are energized and each leaf may be operated through a variable speed drum controller. The electrical interlocks are so arranged that, in closing the span, the reverse sequence must be followed. If the power supply should fail, the bridge is equipped with a gasoline-driven emergency generator which will supply power for all the elements for the movable span and the navigation lights.

The substructure contains 42,000 linear feet of 73-pound steel bearing piles, 14,000 cubic yards of Class "A" concrete, 900,000 pounds of reinforcing steel, 19,000 linear feet of treated timber piling, and 53 M.F.B.M. treated structural timber. The superstructure will, when completed, contain approximately 9,000 cubic yards of Class "A" concrete, 1,180,000 pounds of reinforcing steel, 9,800,000 pounds of structural steel, and 200,000 pounds of machinery and castings.

The total cost of the project will be approximately $5,200,000. The bridge is expected to be opened to traffic in December of this year.

The bridge was designed and its construction supervised by Reynolds, Smith and Hills, and Parsons, Brinckerhoff, Hall & Macdonald, associated architects and engineers. The design work was done under the direct super-

vision of Paul M. Huddleston, a partner in the firm of Reynolds, Smith and Hills. The construction is being supervised by Resident Engineer C. L. Lash.

The substructure was constructed by Diamond Construction Company of Washington, D. C. The superstructure is being constructed by Industrial Contracting Company of Minneapolis, Minnesota, and Allied Structural Steel Companies of Chicago, Illinois, as joint venturers. The electrical work is being done by Miller Electric Company of Jacksonville, Florida, as a subcontractor to the superstructure contractor.

The bridge is owned by the State Road Department of Florida, of which Mr. Sam P. Turnbull is State Highway Engineer, and Mr. W. E. Dean is Engineer of Bridges.

GILMORE STREET BRIDGE

Fig. 1

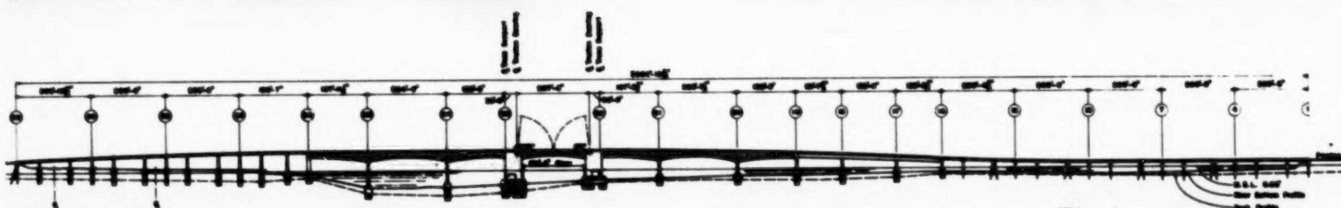
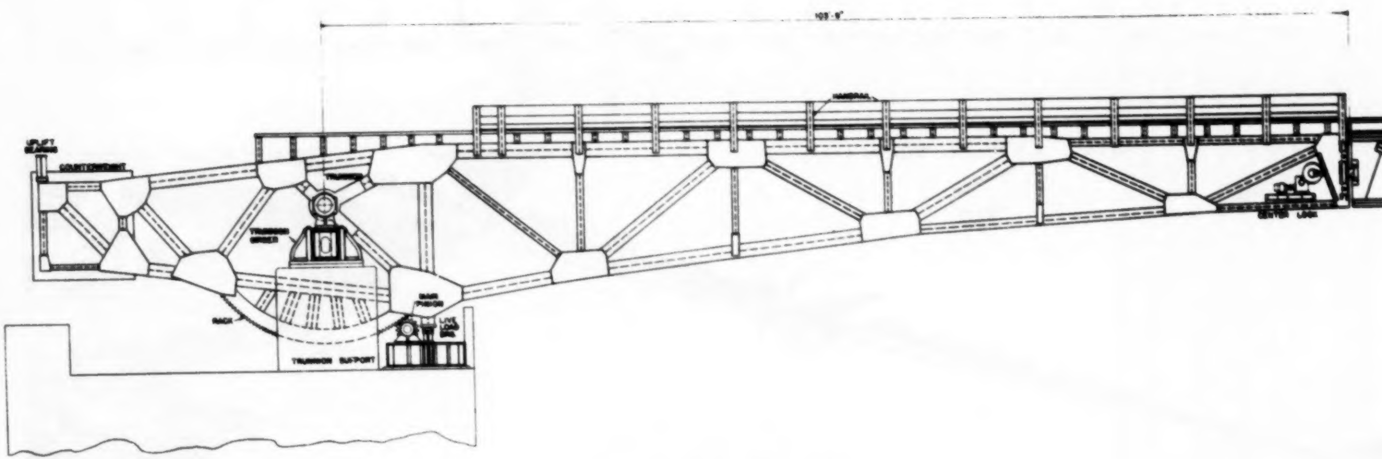


Fig. 2



ELEVATION OF BASCULE TRUSS

GILMORE STREET BRIDGE
JACKSONVILLE, FLORIDA

Fig. 3

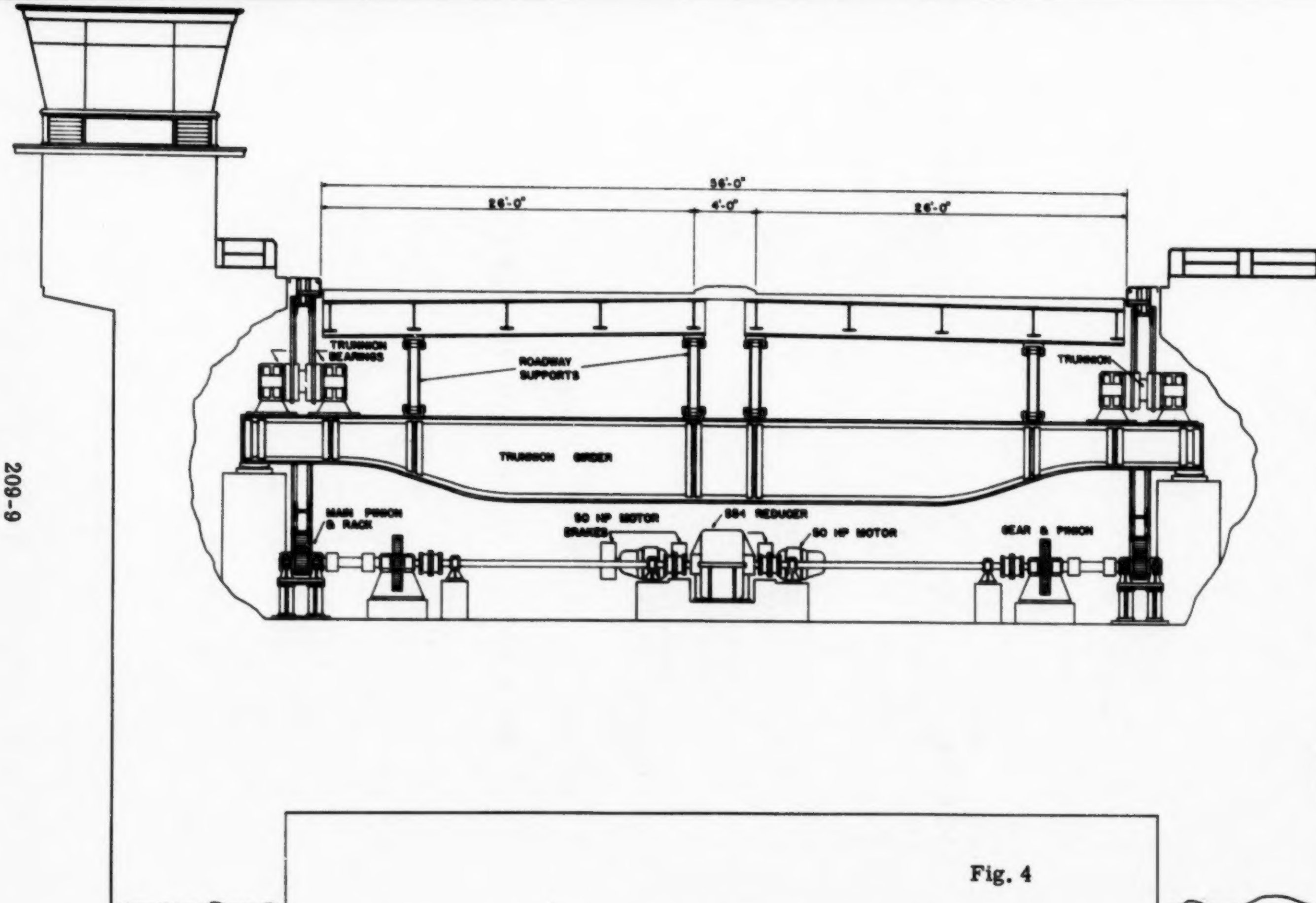


Fig. 4

ELEVATION OF LIFTING MACHINERY

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